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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/590,357	09/14/2006	Jean-Xavier Morin	VA30455	6742

226 7590 03/04/2008

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EXAMINER	
JUETTNER, ANDREW MARK	
ART UNIT	PAPER NUMBER
3749	
MAIL DATE	DELIVERY MODE
03/04/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/590,357	MORIN ET AL.	
	Examiner	Art Unit	
	ANDREW M. JUETTNER	3749	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 February 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *29-58* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *29-58* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

1. The following is a Final Office Action in response to communications received February 11, 2008. Claims 16-28 have been canceled. Claims 29-58 have been added. Claims 29-58 are pending and addressed below.

Response to Amendment

2. Applicant's cancellation of claim 25 makes the 35 U.S.C. 112, second paragraph, rejection moot.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 30-48 and 50-58 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 30-48 and 50-58 are indefinite because they rely on a previously canceled claim, claim 1, or dependent upon a claim which is dependent itself on a canceled claim, claim 1. For the purposes of applying art claims 30-43, 46, and 47 are being interpreted as being dependent upon claim 29 and claims 50-58 are being interpreted as being dependent upon claim 49.

The term "high temperature" in claims 46 and 58 is a relative term which renders the claim indefinite. The term "high temperature" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the

invention. It is unclear what temperature would be considered a "high temperature" to heat the oxygen transport membrane to in order to satisfy the limitation. For the purposes of applying art the term "high temperature" is being interpreted as any temperature about 700°C or higher because that has been indicated as the beginning of the operating range for oxygen transport membranes on page 2 of the specification.

Claim 48 recites the limitation "the high temperature" in line 1 of the claim. There is insufficient antecedent basis for this limitation in the claim. Neither claim 48 nor claims 47 and 29 from which it depends recite a high temperature. For the purposes of apply art claim 48 is being interpreted as reciting that the oxygen transport membrane is heated to a high temperature that is approximately greater than 700 degree Celsius.

Claim 49 recited that the oxygen transport membrane is disposed in "thermal communication" with the firebox. However, neither the specification nor the claims provide any guidance as to what would satisfy “thermal communication.” One skilled in the art would not be appraised of whether "thermal communication" required the membrane structure to physically touch the firebox or if being in contact with hot products from combustion carried out inside the firebox now circulated outside the firebox would be sufficient to satisfy the recited limitation. For the purposes of applying art "thermal communication" is being interpreted as any heat derived from the firebox that touches the oxygen transport membrane.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 49 and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Bool.

<u>In Reference to Claim 49</u>

Anderson teaches:

A boiler (10) comprising:

a fire box (12) in which solid fuel is combusted in the presence of oxygen; and an oxygen transport membrane (140) being disposed in thermal communication with the firebox to provide sufficient heat for the oxygen transport membrane (membrane receives steam from boiler 10 through ducts 138; column 5, line49-

51) and provides the oxygen to the firebox (oxygen membrane releases oxygen which is fed to the firebox through connecting line 142 shown on Anderson fig. 2).

Anderson does not explicitly disclose wherein the oxygen transport membrane extracts oxygen from pressurized air provided thereto.

As to pressurized air being provided to the oxygen transport membrane Anderson teaches that air is supplied (column 6, lines 3-4), but dose not explicitly disclose that it is pressurized. Bool teaches an oxygen transport membrane and combustion system (see fig. 1). Bool teaches that the oxygen flux through an oxygen transport membrane is dependent on the pressure ratios between the source side and the product side (paragraph [0011], lines 3-6). Bool teaches that the supplied air must be compressed, for instance by a blower instead of a compressor, even if the membrane is located within the combustion system of a boiler with an oxygen concentration on the product side that is near zero (paragraph [0011). It would have been obvious to one having ordinary skill in the art at the time of the invention to provide pressurized air to the transport membranes of Anderson in order to drive the transport of oxygen through the membrane as taught by Bool.

<u>In Reference to Claim 50</u>

Anderson as modified by Bool teaches:

The boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), further includes a fluid pressurizing device that pressurizes the air provided to the

oxygen transport membrane (Bool teaches that blower can be used instead of a compressor; end of paragraph [0011]).

8. Claims 29-35, 39, 41, 47, 49, 54, and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 6,505,567 to Anderson et al. (Anderson) in view of US Patent 5,326,550 to Adris et al. (Adris) and US Publication 2002/0073938 to Bool, III et al. (Bool).

In Reference to Claim 29

Anderson teaches:

A circulating fluidized bed boiler (10) comprising:

a fluidized bed containing solids fluidized by a fluidizing gas (36), and

an oxygen transport membrane (140).

Anderson does not disclose a transport membrane being disposed in the fluidized bed. Anderson also does not explicitly disclose that pressurized air is provided to the transport membrane.

Adris teaches transport membranes (34) located in a fluidized bed (12) and above it (See fig. 1 for fluidized bed reactor; see fig. 4 for membrane tubes directly exposed in fluidized bed, column 4, lines 48-56). The transport membranes disclosed in Adris are specifically directed to hydrogen production (column 4, lines 22-29) but the structures and materials are the same as those used in oxygen production. Whether the transport membrane is used in the production of oxygen or hydrogen depends on what gas is provided and is merely intended use.

Based on the disclosure in Adris that transport membranes can be located in a fluidized bed, it would have been obvious to one having ordinary skill in the art at the time of the invention to modify the fluidized bed heat exchanger (36) of Anderson to include the transport membranes (140) inside the fluidized bed as taught by Adris in order to reduce the number of separate components involved in the circulating fluidized bed assembly. The relocating of the oxygen production membranes (140) into the fluidized bed heat exchanger (36) would also result in the oxygen being supplied into fluidized bed heat exchanger then into fluidized bed boiler.

As to pressurized air being provided to the oxygen transport membrane Anderson teaches that air is supplied (column 6, lines 3-4), but dose not explicitly disclose that it is pressurized. Bool teaches an oxygen transport membrane and combustion system (see fig. 1). Bool teaches that the oxygen flux through an oxygen transport membrane is dependent on the pressure ratios between the source side and the product side (paragraph [0011], lines 3-6). Bool teaches that the supplied air must be compressed, for instance by a blower instead of a compressor, even if the membrane is located within the combustion system of a boiler with an oxygen concentration on the product side that is near zero (paragraph [0011). It would have been obvious to one having ordinary skill in the art at the time of the invention to provide pressurized air to the transport membranes of Anderson in order to drive the transport of oxygen through the membrane as taught by Bool.

<u>In Reference to Claim 30</u>

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), wherein the fluidization gas is CO_2 (Anderson, line 170 feeds fluidizing gas through blower 172 to fluidized bed heat exchanger, the gas in 170 is mainly CO_2; column 6, lines 57-60, column 7, lines 4-6).

In Reference to Claim 31

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 30 (see rejection of claim 30 above), wherein the fluidization gas is recycled CO_2 (Anderson, CO_2 being fed in line 170 is recycled from the flue gases; column 7, lines 4-6).

In Reference to Claim 32

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 1(interpreted as 29, see rejection of claim 29 above), further includes a fluid line for providing a combined fluidization gas and oxygen from the fluidized bed to a firebox (see Anderson fig. 2, line between fluidized bed heat exchanger 36 and fluidized bed boiler 10 conducts fluidizing gas and oxygen now that oxygen transport membrane has been integrated into heat exchanger as taught by Adris.

In Reference to Claim 33

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), further includes a fluid pressurizing device that pressurizes the

air provided to the oxygen transport membrane (Bool teaches that blower can be used instead of a compressor; end of paragraph [0011]).

In Reference to Claim 34

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), wherein the oxygen transport membrane is supported within the fluidized solids in the fluidized bed (see Adris fig. 1; separation tubes 28, which can be bare membranes 34, as noted above, are located in the fluidized bed solids 12).

In Reference to Claim 35

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), wherein the oxygen transport membrane is supported above the fluidized solids in the fluidized bed (see Adris fig. 1; separation tubes 28, which can be bare membranes 34, as noted above, are located above the fluidized bed solids 12 in section 14).

In Reference to Claim 39

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), wherein the fluidized bed is external to a firebox (see Anderson fig. 2; the fluidized bed heat exchanger 36 is external to the firebox).

In Reference to Claim 41

Anderson as modified by Adris and Bool teaches:

The circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), wherein the oxygen transport membrane includes long tubes supported by intermediate plates (see Adris fig. 1; tubes 28 may be directly exposed perm selective membranes 34, column 4, lines 48-49, which extend through enclosure 10 supported by the distributor plate 16 the floor of the blow box 18 and the ceiling to enclosure 10).

In Reference to Claim 47

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), wherein the oxygen transport membrane comprises a plurality of oxygen transport membranes (Adris discloses multiple permeable membranes 34, see fig. 1; also it would be obvious to one in the art that multiple membranes in a space will allow for more production of oxygen than a single membrane).

In Reference to Claim 49

Anderson teaches:

A boiler (10) comprising:

a fire box (12) in which solid fuel is combusted in the presence of oxygen; and

an oxygen transport membrane (140) being disposed in thermal communication with the firebox to provide sufficient heat for the oxygen transport membrane (steam is provide from boiler 10 to membranes through ducts 138 as noted in the alternative rejection of claim 49 above) and provides the oxygen to the firebox (oxygen membrane

releases oxygen which is fed to the firebox through connecting line 142 shown on Anderson fig. 2).

However, Anderson as will be modified by Adris below can provide for thermal communication between the solids heated in the firebox and the transport membranes.

Adris teaches transport membranes (34) located in a fluidized bed (12) and above it (See fig. 1 for fluidized bed reactor; see fig. 4 for membrane tubes directly exposed in fluidized bed, column 4, lines 48-56). The transport membranes disclosed in Adris are specifically directed to hydrogen production (column 4, lines 22-29) but the structures and materials are the same as those used in oxygen production. Whether the transport membrane is used in the production of oxygen or hydrogen depends on what gas is provided and is merely intended use.

Based on the disclosure in Adris that transport membranes can be located in a fluidized bed, it would have been obvious to one having ordinary skill in the art at the time of the invention to modify the fluidized bed heat exchanger (36) of Anderson to include the transport membranes (140) inside the fluidized bed as taught by Adris in order to reduce the number of separate components involved in the circulating fluidized bed assembly. The relocating of the oxygen production membranes (140) into the fluidized bed heat exchanger (36) would also result in the oxygen being supplied into fluidized bed heat exchanger then into fluidized bed boiler.

As indicated in the previous rejection of claim 49, Anderson does not disclose wherein the oxygen transport membrane extracts oxygen from pressurized air provided thereto. Anderson teaches that air is supplied (column 6, lines 3-4), but dose not

explicitly disclose that it is pressurized. Bool teaches an oxygen transport membrane and combustion system (see fig. 1). Bool teaches that the oxygen flux through an oxygen transport membrane is dependent on the pressure ratios between the source side and the product side (paragraph [0011], lines 3-6). Bool teaches that the supplied air must be compressed, for instance by a blower instead of a compressor, even if the membrane is located within the combustion system of a boiler with an oxygen concentration on the product side that is near zero (paragraph [0011). It would have been obvious to one having ordinary skill in the art at the time of the invention to provide pressurized air to the transport membranes of Anderson in order to drive the transport of oxygen through the membrane as taught by Bool.

<u>In Reference to Claim 54</u>

Anderson as modified by Adris and Bool teaches:

> The boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), wherein the oxygen transport membrane includes long tubes supported by intermediate plates (see Adris fig. 1; tubes 28 may be directly exposed perm selective membranes 34, column 4, lines 48-49, which extend through enclosure 10 supported by the distributor plate 16 the floor of the blow box 18 and the ceiling to enclosure 10).

<u>In Reference to Claim 57</u>

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), wherein the oxygen transport membrane comprises a plurality of oxygen transport membranes

(Adris discloses multiple permeable membranes 34, see fig. 1; also it would be obvious to one in the art that multiple membranes in a space will allow for more production of oxygen than a single membrane).

9. Claims 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 29 above, and further in view of US Patent 6,532,905 to Belin et al. (Belin).

In Reference to Claim 36

Anderson as modified by Adris and Bool teaches the circulating boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), but does not disclose wherein the fluidized bed is disposed within a firebox.

Belin teaches a fluidized bed boiler (10) with a fluidized heat exchanger (42) with tubes (56, column 5, lines 4-7) located in the furnace enclosure (12) on the hearth (see fig. 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the fluidized bed boiler assembly of Anderson by locating the fluidized bed heater exchanger of Anderson inside the furnace as taught by Belin in order to simplify the overall construction of the circulating fluidized bed assembly and to permit easy access to enclosure walls for maintenance and inspections as explicitly taught by Belin (Column 1, lines 65-67). The resulting structure has oxygen production membranes located on the hearth of furnace section (see Belin fig. 1; 42 is located on hearth of firebox 12). Therefore, claim 36 is obvious in view of Adris and in further view of Belin.

10. Claim 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 49 above, and further in view of Belin.

In Reference to Claim 52

Anderson as modified by Adris and Bool teaches the boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), but does not disclose wherein the oxygen transport membrane is disposed on a hearth of the firebox.

Belin teaches a fluidized bed boiler (10) with a fluidized heat exchanger (42) with tubes (56, column 5, lines 4-7) located in the furnace enclosure (12) on the hearth (see fig. 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the fluidized bed boiler assembly of Anderson by locating the fluidized bed heater exchanger of Anderson inside the furnace as taught by Belin in order to simplify the overall construction of the circulating fluidized bed assembly and to permit easy access to enclosure walls for maintenance and inspections as explicitly taught by Belin (Column 1, lines 65-67). The resulting structure has oxygen production membranes located on the hearth of furnace section (see Belin fig. 1; 42 is located on hearth of firebox 12). Therefore, claim 36 is obvious in view of Adris and in further view of Belin.

11. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 29 above, and further in view of US 5,476,639 to Hyppanen (Hyppanen).

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), but does not disclose wherein the fluidized bed is open to the firebox for receiving descending solids in the firebox.

Hyppanen teaches a fluidized bed reactor (10) that has a heat exchanger (24) located along the firebox wall (26) with openings (40) for particles to enter the heat exchanger (column 7, lines 61-63; see fig. 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the fluidized bed boiler system of Anderson to locate the fluidized bed heat exchanger along the outside of the firebox with openings therein to receive particles from the firebox in order to reduce the number of individual units, reduce the number of connection lines, and improve efficiency. The resulting structure has oxygen production membranes located in the fluidized bed heat exchanger on the outside of the firebox with openings therein to receive descending solid particles. Therefore, claim 37 is obvious in view of Anderson in view of Adris and Bool and in further view of Hyppanen.

12. Claim 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 29 above, and further in view of US 5,054,436 to Dietz (Dietz).

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), but does not disclose wherein the fluidized bed extends along a portion of an inner wall of the firebox.

Dietz teaches a fluidized bed combustion system (see fig. 1) that has a heat exchanger section (24) located along the inner wall of the firebox (10). It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the fluidized bed boiler system of Anderson to locate the fluidized bed heat exchanger in the firebox as taught by Dietz in order to reduce the number of individual units, reduce the number of connection lines, and improve efficiency. The resulting structure has oxygen production membranes located in the fluidized bed heat exchanger on the lower periphery and inner wall of the firebox. Therefore, claim 38 is obvious in view of Anderson in view of Adris and Bool and in further view of Dietz.

13. Claims 40 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 29 above, and further in view of US 5,852,925 to Prasad et al. (Prasad).

<u>In Reference to Claim 40</u>

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), but does not disclose wherein the oxygen transport membrane produces oxygen depleted air which is provided to a waste heat boiler.

Prasad teaches that the byproduct (316) from the membrane gas separation to is not going to be used for combustion can be conveyed to a heat exchanger (35) to recover heat in the form of steam for a power generation cycle (column 8, lines 6-10).

Although, Prasad teaches that the byproduct that is not used in combustion is the oxygen it would have been obvious to one having ordinary skill in the art at the time of the invention to attach the system and heat exchanger as taught by Prasad to the boiler assembly of Anderson as modified by Adris and Bool in order to recover heat from the byproduct stream coming from the membrane separator.

<u>In Reference to Claim 53</u>

Anderson as modified by Adris and Bool teaches the boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), but does not disclose wherein the oxygen transport membrane produces oxygen depleted air which is provided to a waste heat boiler.

Prasad teaches that the byproduct (316) from the membrane gas separation to is not going to be used for combustion can be conveyed to a heat exchanger (35) to recover heat in the form of steam for a power generation cycle (column 8, lines 6-10).

Although, Prasad teaches that the byproduct that is not used in combustion is the oxygen it would have been obvious to one having ordinary skill in the art at the time of the invention to attach the system and heat exchanger as taught by Prasad to the boiler assembly of Anderson as modified by Adris and Bool in order to recover heat from the byproduct stream coming from the membrane separator.

14. Claims 42 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 29 above, and further in view of US Patent 5,284,583 to Rogut (Rogut).

In Reference to Claim 42

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), but does not disclose wherein the oxygen transport membrane includes short tubes with intermediate chambers.

Rogut teaches wherein the high temperature oxygen production membranes (14) consist of short tubes (membranes with long fibers operate at too low of a productivity level, column 2, lines 12-16, the fibers should be in the range of 0.2 to 100 cm, column 3, lines 15-19) with intermediate chambers (transport arteries 12, see figs. 9A, 9B, 15, 16).

It would have been obvious to one having ordinary skill in the art at the time of the invention to substitute the membrane arrangement as taught by Rogut for the membranes of Anderson as modified by Adris in order to increase the productivity efficiency of the oxygen production membranes.

In Reference to Claim 55

Anderson as modified by Adris and Bool teaches the boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), but does not disclose wherein the oxygen transport membrane includes short tubes with intermediate chambers.

Rogut teaches wherein the high temperature oxygen production membranes (14) consist of short tubes (membranes with long fibers operate at too low of a productivity level, column 2, lines 12-16, the fibers should be in the range of 0.2 to 100 cm, column 3, lines 15-19) with intermediate chambers (transport arteries 12, see figs. 9A, 9B, 15, 16).

It would have been obvious to one having ordinary skill in the art at the time of the invention to substitute the membrane arrangement as taught by Rogut for the membranes of Anderson as modified by Adris in order to increase the productivity efficiency of the oxygen production membranes.

15. Claims 43-45 and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 29 above, and further in view of US 7,125,528 to Besecker et al. (Besecker).

<u>In Reference to Claim 43</u>

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), but does not explicitly disclose wherein the oxygen transport membrane includes concentric tubes, an inner tube of which serves as a support for a tube of outer membrane.

Besecker teaches wherein the high temperature oxygen production membranes (52) consist of concentric tubes (54, 56; see fig. 5) of which the inner tube serves as support for the outer tube.

It would have been obvious to one having ordinary skill in the art at the time of the invention to substitute the 2 concentric tubes as taught by Besecker for the

membrane tube taught by Adris in order to allow for a catalytic reaction to take place after the oxygen is separated from the oxygen-containing gas (column 5, lines 24-27).

<u>In Reference to Claim 44</u>

Anderson as modified by Adris, Bool and Besecker teaches:

The circulating fluidized bed boiler of claim 43 (see rejection of claim 43 above), wherein a space is provided between the concentric tubes (see Besecker fig. 5; column 6, lines 40-47).

<u>In Reference to Claim 45</u>

Anderson as modified by Adris, Bool, and Besecker teaches:

The circulating fluidized bed boiler of claim 44 (see rejection of claim 44 above), wherein the air flows in counter- current in the space between the tubes (air is capable of being conducted in counter flow thru 27 and the gap between 54 and 56.

<u>In Reference to Claim 56</u>

Anderson as modified by Adris and Bool teaches the boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), but does not explicitly disclose wherein the oxygen transport membrane includes concentric tubes, an inner tube of which serves as a support for a tube of outer membrane.

Besecker teaches wherein the high temperature oxygen production membranes (52) consist of concentric tubes (54, 56; see fig. 5) of which the inner tube serves as support for the outer tube.

It would have been obvious to one having ordinary skill in the art at the time of the invention to substitute the 2 concentric tubes as taught by Besecker for the membrane tube taught by Adris in order to allow for a catalytic reaction to take place after the oxygen is separated from the oxygen-containing gas (column 5, lines 24-27).

16. Claims 46, 48, and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 29 above, and further in view of US 5,108,465 to Bauer et al. (Bauer).

In Reference to Claim 46

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 1 (interpreted as 29, see rejection of claim 29 above), but does not explicitly disclose wherein the oxygen transport membrane is heated to a high temperature.

Bauer teaches that the oxygen conductivity of oxygen ions in oxygen transport membranes depends on the temperature (column 2, lines 67-68). Bauer also discloses that optimum values are obtained at high temperatures (column 3, line 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to heat the oxygen transport membranes of Anderson to a high temperature in order to obtain optimum oxygen ion transport though the membrane as taught by Bauer.

In Reference to Claim 48

Anderson as modified by Adris and Bool teaches the circulating fluidized bed boiler of claim 47 (see rejection of claim 47 above), but does not explicitly disclose wherein the high temperature is approximately greater than 700 degrees Celsius.

Bauer teaches that the oxygen conductivity of oxygen ions in oxygen transport membranes depends on the temperature (column 2, lines 67-68). Bauer also discloses that optimum values are obtained at high temperatures in the range of 400-1100°C (column 3, lines 1-3).

It would have been obvious to one having ordinary skill in the art at the time of the invention to heat the oxygen transport membranes of Anderson to a high temperature in the range of 400-1100°C in order to obtain optimum oxygen ion transport though the membrane as taught by Bauer.

<u>In Reference to Claim 58</u>

Anderson as modified by Adris and Bool teaches the boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), but does not explicitly disclose wherein the oxygen transport membrane is heated to a high temperature.

Bauer teaches that the oxygen conductivity of oxygen ions in oxygen transport membranes depends on the temperature (column 2, lines 67-68). Bauer also discloses that optimum values are obtained at high temperatures (column 3, line 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to heat the oxygen transport membranes of Anderson to a high temperature in order to obtain optimum oxygen ion transport though the membrane as taught by Bauer.

17. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson in view of Adris and Bool as applied to claim 49 above, and further in view of US 5,239,946 to Garcia-Mallol (Garcia-Mallol).

Anderson as modified by Adris and Bool teaches the boiler of claim 1 (interpreted as 49, see rejection of claim 49 above), but does not explicitly disclose wherein the oxygen transport membrane is disposed on the periphery of the lower portion of the firebox.

Garcia-Mallol teaches a fluidized bed combustion system (see fig. 1) that has a heat exchanger (36) located along the outside of a wall of the firebox (18). It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the fluidized bed boiler system of Anderson to locate the fluidized bed heat exchanger along the outside of a wall of the firebox as taught by Garcia-Mallol in order to reduce the number of individual units in the assembly, reduce the number of connection lines, and improve efficiency. The resulting structure has oxygen production membranes located in the fluidized bed heat exchanger outside a lower periphery wall of the firebox. Therefore, claim 51 is obvious in view of Anderson in view of Adris and Bool and in further view of Garcia-Mallol.

Response to Arguments

18. Examiner acknowledges that the rejections previously made are moot given that claims 16-28 have been cancelled as applicant has argues in remarks paragraphs 1, 2, and 4.

The applicant has indicated in paragraphs 3 and 5 of the remarks that independent claims 29 and 49 have been added and has emphasized particular language in the claims. Examiner has cited prior art in the rejection of those claims above which satisfies all limitations of claims 29-58.

Conclusion

19. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANDREW M. JUETTNER whose telephone number is (571)270-5053. The examiner can normally be reached on Monday through Friday 7:30am to 5pm Est..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steve McAllister can be reached on (571) 272-6785. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

21. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AMJ
/A. M. J./
Examiner, Art Unit 3749